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ABSTRACT

The paper summarizes several approaches to the identification of learning disability and then discusses the nature of learning disability in the context of competing hypotheses as possible explanations of insufficient or unsatisfactory achievement. Because learning disability may only be inferred as a cause of unsatisfactory learning, the information requirements of adequate diagnosis are postulated, and a researchable theoretical network of relationships is presented. Learning disability is seen as a breakdown either in the neurological process or a result of some physically damaging event or situation, or as an impairment of mental functioning as a result of a profound deprivation of stimulating environment. The latter alternative is seen to be highly speculative, but to afford a possible explanation of cases of disability which do not show signs of neurological impairment. The complexity of learning disability is recognized by this approach and suggestions are made for studying the phenomenon. (Author/SBH)

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Toward A Definition of Learning Disability

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Running head: Toward A Definition

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Abstract

This paper summarizes several approaches to the identification of learning disability and then discusses the nature of learning disability in the context of competing hypotheses as possible explanations of insufficient or unsatisfactory achievement.

Because theory has a fundamental role in a useful definition, the criteria for an adequate theory are discussed in the context of learning disability and the effects of theory on problems of evaluation are considered.

Specific review of the literature further documents the need for a theoretical approach. The wide array of terms used to describe or denote the presence of learning disabilities is discussed. The apparent problem with these "descriptors" is that they are "symptoms" and/or "conditions." Thus, they not only fail to address the actual cause(s) of a problem, but do not even allude to any approach to treatment.

Several current theories of learning disability are explored here and we observe that a similarity exists among certain aspects of the reported findings. Learning disability is seen as a breakdown of cognitive processing resulting from some physically damaging event or situation, or from a profound deprivation of stimulating environment. The focus of this paper is upon the consequences of such impairment upon the processes.

A preliminary sketch of a theory of learning disability is then presented and an explanation of the relationship of its components is briefly described. In the hierarchical nature of the processes we point out the element of interaction or dependency, as being central to the proper functioning of the processes. These processes are defined and illustrations of possible breakdowns are discussed.

The complexity of learning disability is recognized by this approach and several suggestions are made for studying the phenomenon. A necessary step toward a general theory of learning disability is to develop a major program of research geared toward all children and to use a variety of measurement techniques to test the related hypotheses. The theory, in turn, will provide a coherent and complete definition.

Abstract

This paper reviews and summarizes the approaches to the identification of learning disability presented in the two previous papers. It then discusses the nature of learning disability in the context of competing hypotheses as possible explanations of insufficient or unsatisfactory achievement. Because learning disability may only be inferred as a cause of unsatisfactory learning, the information requirements of adequate diagnosis are postulated, and a researchable theoretical network of relationships is presented. Learning disability is seen as a breakdown either in the neurological process or a result of some physically damaging event or situation, or as an impairment of mental functioning as a result of a profound deprivation of stimulating environment. This latter alternative is highly speculative, but affords a possible explanation of those cases of disability which do not show signs of neurological impairment. The complexity of learning disability is recognized by this approach and suggestions are made for studying the phenomenon.

Toward A Definition of Learning Disability

The Nature of Theory

To be worthy of the designation, theory, an organized set of ideas about a set of phenomena must meet several criteria. These criteria may be found in many forms in the literature of science. A recent example is presented in Sternberg (1977).

Sternberg discusses the criteria of completeness, specificity, generality, parsimony, and plausibility. Completeness, as the term implies, requires that the theory account for all of the processes involved in the phenomena. A theory may be complete, however, but lack specificity. Processes may be identified but their workings are not described in detail sufficient to establish empirical tests of their presence and operation. Specificity is defined as adequate detail to permit the derivation and testing of appropriate hypotheses.

Generality is also a desired quality because the utility of a theory is often directly related to its breadth of applicability. It refers to the ability of theory to explain data derived from a variety of sources by a variety of methods.

Parsimony is a highly desired quality because it involves reduction to the minimum the number of assumptions to be made and the number of parameters to be measured and evaluated. Parsimony may require a tradeoff with completeness and specificity, especially in a complex situation such as that represented by the phenomena associated with the label "learning disabilities".

Plausibility is both intuitive and empirical. It is intuitive in the sense that obvious reasonableness may lead to less skeptical acceptance and therefore more immediate utility, but it is primarily empirical, because plausibility refers to the ability of the theory to account for experimental data which may occur when the theory is under test.

Perhaps the most important practical criteria which must be met in theory building are the first two, completeness and specificity. In order to evaluate the adequacy of any theory it is necessary to derive hypotheses from it and to develop methods of subjecting them to empirical test. Also, these hypotheses must be derivable and testable for all parts of the theory.

Before turning to the emergence of adequate theory in the context of the problem of learning disabilities, the impact of theory on the problems of measurement should also be considered. In the field of learning disabilities there are numerous tests and evaluation procedures which are purported to aid in identifying and providing services to learning disabled children. There are also numerous criticisms of their validity and therefore their usefulness (see, for example, Arter and Jenkins 1979, and Coles 1978). The function of theory is well demonstrated by Messick (1975) in his discussion of construct validation. He makes the point that all validity is ultimately construct validity, and construct validity is that property of a measure which is consistent with the underlying theoretical construct that is the basis for the inquiry and action to be taken. Thus, the removal of the justifiable criticisms of existing measurement in the field of learning disabilities would be significantly assisted by the availability of an adequate theory of learning

disabilities. Indeed, Wozniak (1979) makes the development of theory the major recommendation for a research focus after review of the progress made in the field of learning disabilities by Soviet psychoeducational researchers. Finally, our own research on learning disabilities (Campbell and Varvariv, 1979) demonstrated the inadequacy of the popular discrepancy definitions and led us to search for an adequate theory upon which to base both working definitions and appropriate measurement.

Aspects of Learning Disabilities

The most common approach to the problem of describing learning disabilities (LD) appears to proceed from a listing of things that LD is or is not. The proposed federal definition, for example, lists deficits in ability to "think, listen, speak, read, write, spell, or do mathematical calculations". It excludes these problems if covered by "visual, learning, or motor handicaps, or mental retardation, or emotional disturbance, or environmental, cultural, or economic disadvantage" (Federal Register, 1976).

Another example of the listing approach is reported by Farnham-Diggory (1978). It refers specifically to that aspect of learning disability which is labelled hyperactivity and includes such items as fidgets, rocks, wets bed, sets fires, defiant, heedless of danger, and many accidents.

A major problem with these lists, of course, is that they not only fail to explain in any systematic way the nature of the problem but they do not suggest any approach to treatment. They are, in fact, merely symptoms of the problem which would need to be accounted for by an adequate theory. This is an example of the theory's property of generality.

In addition to these listings, a perusal of the literature on learning disabilities will quickly identify notions such as dyslexia, minimal brain damage, hyperactivity (mentioned above), perceptual disability, hemispheric conflict and developmental aphasia (see Lerner 1976; Johnson and Morasky, 1977). Further complication is found in the interplay between the causes of the observed learning problems and their consequences. Some advocates and researchers have focussed upon the origins of a condition that resulted in learning problems. They have directed their attention to such sources as diet, birth injury or social neglect as an explanation of the phenomenon (see Weber Ed., 1974). Others have theorized about the physical location of certain functions in the brain and about corresponding breakdowns in the interconnections of these locations as the source of the problem (Knights and Bakker, 1976; Johnson and Myklebust, 1967). Still other researchers are focussing attention on approaches to information processing as a clue to understanding the problem (Kirk and Kirk, 1971).

Some of the perceptual-motor, motor, and language approaches did develop with remedial intent, as did the information processing approaches (Lerner, 1976). One of the most noted information processing approaches is the ITPA, Illinois Test of Psycholinguistic Ability. The ITPA is a classic example of a diagnostic instrument which purports to assess differences in perceptual abilities of individual children in order to organize appropriate remedial programs for each child. It focusses basically on modalities used for receptive and expressive communicating. As Farnham-Diggory (1978) points out, this last approach seems to be utilizing, at last, the recent contributions of cognitive psychology whereas many of the other approaches have their

foundations in work done a half-century or more in the past. However, a recent review of validation studies on the ten most frequently recommended procedures used for diagnostic learning disabilities indicates that, while there is some support for the diagnostic validity of the ITPA and similar tests, many investigators find the tests deficient in prediction of academic achievement and appropriate remediation (Coles, 1978).

Thus the present state of the art strongly underscores the necessity for a coherent set of concepts which are testable and will provide a plausible explanation of the learning phenomena observed.

Some Theories of Learning Disability

Although an exhaustive review of current theories of learning disability is beyond the scope of this paper, it may be useful to consider certain examples.[1] A promising approach from the point of view of information processing is the work of Senf and his associates (Senf, 1972; Senf and Frundl, 1971). His theory postulates a facility of selective attention to incoming information, which is organized and integrated to become the basis of behavior. There is an interaction between the "information array" where the incoming information is stored and what Senf calls the internal environment. This latter term includes the individual's store of memories, reactions to the incoming information and the physical dynamics of the individual. The theory attempts to account for the role of motivation, selective attention, and reinforcement. In essence it focusses on how the individual acts upon and interacts with external stimuli.

Within the context of this theory, learning disabilities are considered to be breakdowns of the information processing and integrating system. Four points of dysfunction are postulated. They are: failure to receive proper information, failure to produce the proper information in the informational array, failure of the informational array to evoke appropriate neural activity, and failure of selectivity in the content of the informational array.

There is a marked similarity between certain aspects of Senf's approach and that demonstrated by the Russian psychologists as reported by Wozniak. The parallel is found between the Russian notion that ability is developed because "the individual becomes capable of detaching practical activity from its specific social-physical context, abstracting, generalizing, and internalizing the structure of the activity as the organizational basis for higher mental functions such as complex perception, voluntary memory, and logical thought" (Wozniak, 1979) and Senf's notion that the human organism actively generates its own pattern of information processing by utilizing its past cognitive-experiential repertoire. Both the Russian psychologists and Senf and his colleagues report empirical data that support aspects of their theories. Both, however, contain hypotheses which are in need of further verification, and do not necessarily account for the presence of individual differences in the child's choice of areas for selective attention. The theories are, however, potentially informative in developing a better understanding of the phenomena of LD.

From Theory of Normal Process to Theory of Disabled Process

Because the idea of learning disabilities is by definition the breakdown of presumably normal abilities, it follows that an adequate theory of LD should be a counterpart of a theory of successful intellectual functioning. Sternberg (1977) reviews the existing theories in this area and points out that all have their unique problems and none provide sufficient explanatory power to resolve the problems or explain observed phenomena. In particular, he points out that information processing theories tend to be fragmented, there are problems of confounding in most of the models used to test them, and those which are based on computer programs are frequently nonparsimonious and difficult both to understand and to replicate.

He presents a theory of analogical reasoning that suggests the form of a general theory of intellectual functioning. The specific aspect of this overall theory, which is labelled A Componential Theory of Analogical Reasoning, has provided a good fit to empirical data developed from several types of stimuli, and therefore appears to have generality. Although the research necessary to the development of the theory beyond analogies to general intellectual functioning is by no means complete, the direction appears promising.

The general theory is postulated to be made up of the levels of components, tasks, reference abilities, and general intelligence. The components represent the breakdown of the tasks in terms of the process which must occur for the completion of the tasks. It is at this point that the theory suggests an approach to the problem of learning disability.

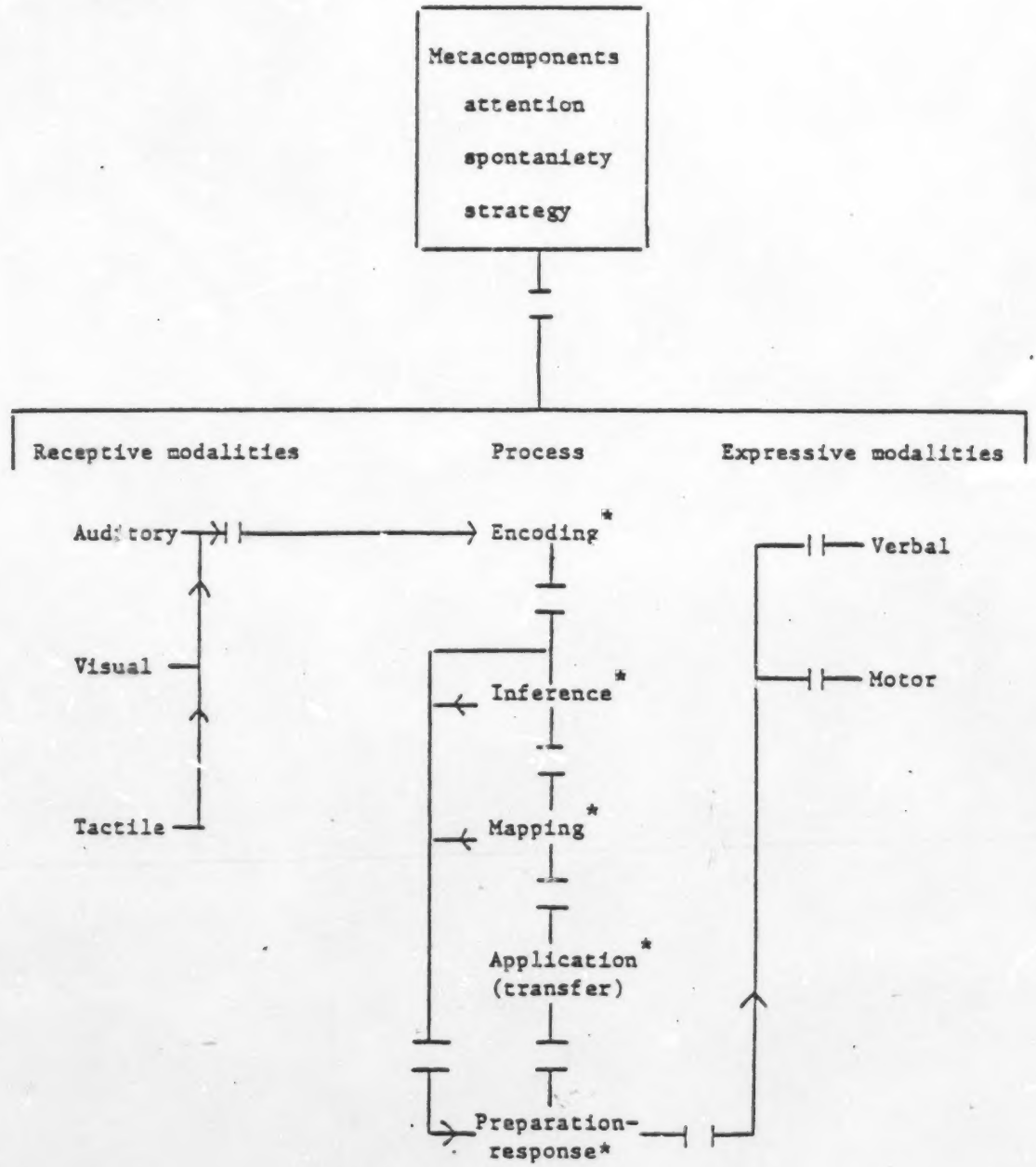
Sternberg's components are identified as encoding, inference, mapping, application, preparation-response, and justification. The first five components are general for the analogy problem. The sixth is required for certain kinds of problems -- those that require a judgment of best fit rather than an unequivocal solution. Experiments have been devised that successfully differentiate each of the components, with the exception of application and preparation-response time, which remain confounded with each other. A great deal can be learned, however, in assessing an individual's performance among the differentiable components. Each of these may be thought of as a process, and therefore they become the basis for devising a theory of learning disability.

The preliminary sketch of a theory of learning disability may be seen on the following page.

The terms expressed in the diagram are defined with reference to their use by both theoretical workers and by practitioners. As used in this presentation the auditory modality refers to the reception of stimuli through hearing and a breakdown in this modality refers not to an inability to hear as in deafness, but to an inability to utilize aural stimuli in the encoding process. The visual and tactile modalities are defined similarly. Thus the present theory is utilizing both the notion of modalities, presented by other information processing approaches such as the ITPA, and the central processing concepts introduced by Sternberg.

The processes warrant most careful attention. The terms as used in this diagram are parallel in definition to their use by Sternberg in his

Preliminary Sketch of a Theory of Learning Disability [a]



Breakdown between (⊣⊢) or within (*) any points represents LD.

[a] This sketch was developed in the course of many discussions with my colleague, Dora Varvariv. Her contribution is acknowledged with thanks.

Componential Theory of Analogical Reasoning but are expanded as necessary to include intellectual functioning on a more general level than analogical problem solving.

Because the processes presented in this theoretical sketch appear to be both discrete and hierarchical in nature, a clarification of their relationship is in order before proceeding with the definitions. The quality of discreteness is inherent in the process to the extent that each process fulfills a specific function which is not fulfilled by any other process. Nevertheless, the processes show a lack of discreteness to the extent that each process cannot stand alone when responding to a specific task. Only the first process of encoding has this ability. The reason for this phenomenon lies in the hierarchical nature of the processes.

In a task requiring only encoding, for example, it is possible to go from a receptive modality through the encoding process to an expressive modality. To illustrate, a blindfolded normal subject can touch a piece of burlap and then select another piece of burlap from among samples of burlap, velvet, and silk without drawing any inferences about cloth or considering any form of the relationship between burlap and silk or velvet, but rather only the difference in texture. Here, the processes subsequent to encoding are not utilized. Similarly, the processes subsequent to inference are not required for an inference-oriented task. On the other hand, a specific process (excluding preparation-response) cannot operate without the immediately preceeding processes. The fact that the subsequent processes are not required for a task, but the preceeding ones are exemplifies the notion that as an intellectual

function becomes more complex it is expected that the processes will be involved sequentially in the activation of that function. While the sequential functioning of the processes is demonstrated by Sternberg through the analogy task and its subtasks, it may also be demonstrated through a set of discrete tasks, as in the example above, if one wishes to examine the success or failure of a given process.

The element of interaction is inherent in the hierachical nature of the processes in more than one way. As indicated, Process A is needed for Process B to function properly. However, Process B, in turn, helps Process A function to the best of its ability. For example, a child cannot infer the relationship between two terms until he/she can encode the words. But if the child is capable of grouping words into categories, a step involved in inferring relationships, he/she can then be better in remembering the words for encoding the next time encoding of those words is required.

Thus, elements of inference may aid in encoding and elements of encoding, at the concept level, may aid in inference. The researcher is therefore compelled to consider the most central characteristics rather than the overlapping elements of a process in defining it. With this understanding in mind we will examine the meaning of the given terms.

The first process term, encoding, is seen to include discrimination among such stimuli as sounds, words, word images, word attributes, colors, textures, the spatial and temporal processing of these stimuli and both short and long term memorization.

The inference process is defined as that process which involves the grouping of several stimuli with a common property or the development of a concept from the common property of several different stimuli. It is within the inference process that a verbal label is attached to a characteristic shared by a group of stimuli. Thus the concept name "rough" might be applied to burlap, canvas, and homespun, and the complex concept "smooth and soft" to velvet, plush and a densely flocked material.

The next level of processing is labelled mapping in the diagram. It refers to the process of discovering a pattern of associations between two groups or two multifaceted individuals which may be applied to other groups as a way of discovering their association. It is most commonly applied to analogies, but is applicable in more general terms. If, for example, one has discovered that defoliating a tree means removing leaves and deflating a tire means removing air, the prefix de must be associated with some form of removal.

The next process in the hierarchy is application. It involves considering a specific case in terms of the rule and determining the meaning of the case, such as, for example, defrock or deport. This process may also result in the production of the image of an object (word, concept) which might fit the rule in a specific circumstance requiring a search for an appropriate response.

Application does not appear to be at a higher level of difficulty than the preceeding process, mapping, but of necessity follows it in sequence.

The final process that Sternberg theorizes and which appears generally plausible for the broader array of intellectual functioning is preparation-

response. It appears to be partly a control function which selects the method of response, and in terms of the present theoretical diagram, flows directly into the response modalities.

There is another facet of intellectual functioning which is discussed by Sternberg and in somewhat different terms by Senf. In Sternberg's (1978) approach this facet of intellectual functioning is labelled a metacomponent. It appears to be a product of the individual's prior experience, personality, and overall ability. It contributes to the selection of a strategy for problem solving and to the degree of concentration on each of the processes within the problem solving function. Sternberg has found evidence that higher performing subjects may spend more time on encoding and require less time for the subsequent processes. Senf refers to the phenomena of selective attention as almost always involved in breakdowns of normal intellectual functioning. He regards them as secondary, however. The Soviet psychologists, as reported by Wozniak, also appear to take the position that the individual develops the ability to select appropriate strategies on the basis of prior experience. Metacomponent appears to be a general control function and, as we shall discuss later, may be a source of the possible breakdowns which can be characterized as learning disabilities.[2]

In summary then, the concept of general intellectual functioning presented herein is comprised of: receptive modalities; a series of processes that are utilized more or less depending upon the complexity of the problem; response modalities; and a control function that directs the utilization of the other parts of the system. A consideration of the possible breakdown points in this system will provide a theoretical concept of the phenomenon of LD.

Learning disabilities can be conceptualized as a family of problems which have a variety of impacts on the individual and may result from a variety of breakdowns or dysfunctions. The conceptualization presented in this paper does not deal with the causes of the dysfunctions in a physiological damage or other pathological sense but rather with their presence and consequences.

The breakdowns may occur between reception and processes, within or between processes, between processes and expression, or between the control component and any of the other elements of the intellectual functioning system. These may result in a variety of academic or social failures. Lack of success in academic or social learning is however a summative kind of observation and provides very little information about the reasons for or the locations of the contributing problem. Therefore a consideration of the specific points of breakdown is necessary to provide adequate understanding of the problem of learning disabilities.

To illustrate, a breakdown between the receptive modalities and encoding could result in sparse and incomplete encoding, which in turn would inhibit inference and the subsequent processes. A breakdown within encoding could result in inability to selectively attend to available stimuli and result in hyperactive and directionless behavior. A breakdown in inference and mapping could result in failure to anticipate the consequences of social acts and therefore permit without restraint unacceptable social behavior which is sometimes seen as a symptom of learning disability. As an example, a child with such a breakdown may be unable to attach the consequences of a particular impulsive act to the act itself and therefore will not sense any restraint

based upon experience, when faced with a similar impulse on another occasion. Finally, a breakdown in the control component could result in the selection of inappropriate strategies for problem solving and consequent high error rates with corresponding inappropriate performance. Generally, a breakdown in any process would logically lead to inadequate functioning of the subsequent processes, and may also lead to a sub-optimal functioning of the preceeding processes-given that process B may help process A to operate.

This view of learning disabilities allows for consideration of the varieties and complexities of learning problems and focusses attention on the locations of areas requiring detailed attention. The remaining tasks are simply stated but not simple in execution. They are the derivation of a network of expected relations or predictable outcomes to serve as tests of adequacy of the theory, the development of data collection procedures that permit the emergence of the relationships if they in fact exist, and the development of treatment strategies based upon these findings.

It is beyond the scope of this paper to explore these tasks in detail, but the next section will suggest some promising directions.

One method of demonstrating the empirical plausibility of this approach to understanding learning disabilities has been suggested by the precuing experiments of Sternberg (1977). He dealt only with the analogies problem, but has conducted a series of experiments which have produced consistent results for his Componential Theory of Analogical Reasoning. These results suggest that the time required to complete each process can be differentiated, and that this differentiation provides some evidence of the existence of a process which

functions in the hypothesized way. The time spent by the subject in successive stages of problem solving, each of which can be reasonably assumed to include sequentially more of the processes, is treated subtractively to isolate the actual time on any one process. Also certain correlational relationships are predicted.

Building upon these experiments, the elements of the expected networks and outcomes can be sketched. The goal of this design is to devise a method of identifying the results of each process independently, and thereby determining if it relates in the expected way to other processes and produced outcomes that are functionally correct. This is not, with the present state of the art, directly possible. However it is possible to design several tasks that isolate the encoding process, and by successively adding task requirements, to provide an estimate of the presence and state of the subsequent processes.

The general diagram of intellectual functioning begins with reception through several modalities, followed by encoding. It is also hypothesized in the diagram that it is possible to move directly from encoding to preparation-response and an expression modality. To isolate the integrity of the encoding process, all that is necessary is to show that it occurs whatever the modality of input and whatever the expressive modality. The example given of differentiating burlap from velvet and silk illustrates such a task. The expressive mode could be varied from a motor response of pointing to a verbal "yes" or "no" when the samples were presented individually. Short term memory could be controlled or eliminated. If the encoding process is intact, the next task would add an element of inference. At a simple level this could be a

tactile grouping task, in which samples of cloth were sorted into two or more groups, each characterized by the same texture. The score (either accuracy or time required) for this task minus the comparable score for the first task becomes the inference score. The third task would require the conceptualization of a rule and its application. Such a task would be the sorting of a group of cloth samples into two groups defined by classes of texture such as roughness or smoothness, with variations in degree within classes requiring a conceptualization of these properties. We have not yet found a way to disentagle application from this set of processes without resorting to language. If language stimuli had been found to be intact through the inference process, it would be possible to modify the task by requesting the selection or production of a word response which would indicate whether the mapping technique had been completed prior to application.

Whether this design modification is incorporated or not, it is at this point possible to state some expected comparative relationships. Because both encoding and inference are assumed to be necessary but not sufficient processes for mapping, the multiple correlation of both should be larger than the zero order correlation of either with mapping unless the activity in one process includes a substantial portion of variance which inhibits the operation of the other process. That situation, however, should be associated with negative correlation between the first two processes and could therefore be evaluated.

We envision a program of research which will test these hypotheses with children who are successfully functioning in school as well as those who are not. If processes as defined are involved in learning disabilities, there

should be significantly observable differences in the intactness of processes between the successful and unsuccessful children. The nature of the data collection required is our next consideration.

To adequately test the theory in terms of plausibility and generality it is required that the hypothesized relations and outcomes occur under a variety of situations assessed by a variety of measurement devices. At the stage of theory testing it is assumed that individual rather than group assessment will be the primary data collection procedure. There are two kinds of data which are frequently used to represent task performance in theory testing: response time and task success data. A combination of these kinds of data appears to be required for the testing of this theory. In particular, task success appears to be appropriate for assessing the linkage between receptive modalities and encoding, but the addition of time-on-tasks or latency should provide useful additional information as additional processes are assessed. Examples of related research which utilize both methods of assessment include Sternberg's work previously cited, and Butter and Vallano's (1978).

In particular, the interaction between latency and accuracy may be useful in identifying the role of, or problems associated with, what Sternberg calls the metacomponents. He suggests that accuracy may be related to strategy selection, with corresponding changes in the latency patterns for the processes.

In addition to the kind of data produced by the required measurement, the content of the assessment devices must also be varied to provide a basis

for evaluating generality. Examples of content which were tactile in nature have been used illustratively earlier in this paper. Content may be expanded to include not only verbal and figural material, but also may be varied in level of conceptual complexity. In verbal terms the complexity variation could be provided by representing common nouns at the simple level and abstract adverbs at a more complex level. For figural material, the number of characteristics which must be taken into account could be varied. The latency and error rate would both be predicted to increase as complexity increased.

By utilizing this variety of measurement approaches, a multi-trait, multi-method (Campbell and Fiske, 1959) test of the theory becomes possible.

The question of suggested treatment can only be speculated about at this stage of development. If the location of breakdowns can be identified in terms of receptive modes, processes, or expressive modes, however, the nature of appropriate treatment can probably be specified with more confidence than is presently justified. While the summary of completed research by Arter and Jenkins (1979) did not suggest high feasibility for differential treatment, the reason probably lies in inadequate definition and measurement of the modalities, the processes and the corresponding treatments. There is no reason to believe, given the variability of individual approaches, that the successes obtained by competent learning disability specialists have come about without a great variety of individually tailored instructional strategies.

What is lacking is a coherent way to organize these approaches in terms of the individual needs they address. That is the function of a general theory of learning disabilities. This beginning sketch suggests the direction that research on such a theory might take.

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Footnotes

[1]The reader is referred to the summary of current theories by Wong (1979) and the historical review by Farnham-Diggory (1978) for excellent and extensive coverage.

[2]A comprehensive discussion of attention, which we classify as a meta-component, is presented in "The Perceiver as Performer" by Gibson and Rader, in the book Attention and Cognitive Development, Hale and Lewis (Eds.), 1979.